Proximate Determinants of Fertility Estimation Tool: Methodology

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1. Description

The **Proximate Determinants of Fertility Estimation Tool** calculates the aggregate versions of the Bongaarts (1978, 1982) and Stover (1998) variants of the proximate determinants model. Total fertility rates (TFRs) are estimated using survey-based measures of the proximate determinants of fertility, either as a single survey-based estimate or as an estimate from one survey relative to a second survey or benchmark TFR estimate.

This tool can be used for various purposes in applying the proximate determinants model, including: (1) identifying how changes in the various proximate determinants affect fertility; (2) assessing the reliability of one survey-based estimate given a second survey-based estimate or other reference estimate; (3) projecting levels of contraceptive prevalence required to achieve a specific TFR in future; or (4) projecting levels of TFR associated with a specific change in modern or traditional contraceptive methods in the future.

2. Data Required

The variables used to measure the proximate determinants of fertility are available from the final reports or from the StatCompiler of the Demographic and Health Surveys. For more information, please reference the Input Data Guide included with this product.

2.1. Bongaarts variant

If a relative estimate is to be calculated, these inputs are required from two surveys. If a relative estimate is to be calculated using a benchmark estimate of TFR (e.g., a trusted estimate for the year of the earlier of two surveys), that TFR is also required.

(1) Age-specific fertility rates for age groups 15-19 through 45-49

(2) Age-specific proportions married for age groups 15-19 through 45-49

(3) Proportions of married women 15-49 using specific methods of contraception

(4) Use-effectiveness of these methods

(5) Mean duration of postpartum insusceptibility

(6) Total abortion rate

(7) Proportion of women 45-49 who have had no live births

2.2. Stover variant

Again, if a relative estimate is to be calculated, these inputs are required from two surveys. If a relative estimate is to be calculated using a benchmark estimate of TFR, that TFR is also required.

(1) Number of women ages 15-49, number of married women ages 15-49, and number of unmarried women ages 15-49, if any, who were sexually active during the past month

(2) Proportion of women ages 15-49 who are not now sexually active but who are currently pregnant or abstaining postpartum

(3) Proportions of married women 15-19 through 45-49 and proportions of sexually active unmarried women ages 15-19 through 45-49 using specific methods of contraception

(4) Use-effectiveness of these methods

(5) Mean duration of postpartum insusceptibility

(6) Total abortion rate

(7) Proportion of women 15-49 who are menopausal and proportion who are infecund or subfecund for another reason

3. Assumptions

Total fertility is modeled as the product of a series of indices reflecting the fertility reducing impact of five proximate determinants of fertility and a baseline measure of fecundity – either total fecundity (in Bongaarts' model) or potential fertility (in Stover's model). Total fecundity can be assumed to be 15.3, roughly the average value estimated by Bongaarts, if it is unknown. Potential fertility can be assumed to be 21.0, the average calculated by Stover, if it is unknown.

Default use-effectiveness measures for specific contraceptive methods are provided in the workbook. Users are encouraged to input country-specific and updated effectiveness estimates (and overwrite the defaults) where such data are available and of acceptable quality, given effectiveness of methods varies across countries and over time.

4. Limitations

The Proximate Determinants of Fertility model on which this tool is based was developed for the purpose of measuring the relationship between fertility and the behaviors and biology that lead to fertility change in populations. Because the model was not designed to achieve an accurate estimate of the TFR, the TFR estimates generated by the tool will necessarily differ from those derived from Demographic and Health Survey questions about births within the recent (and distant) past, as provided in the DHS STATCompiler and survey reports. Instead, the tool quantifies factors that explain fertility differentials. Its results can provide new, specific indicators for use in larger analyses of the social, economic, and cultural factors that work through the proximate determinants to influence fertility. They can also serve as the basis to formulate projections of fertility change, based on expected and policy-driven change among one or more proximate determinants.

Though the model and implementing tool can contribute to fertility analyses and program planning, results can be affected by the typical limits of survey data, including standard error differentials across variables and over time, as well as differences in measurement periods across variables.

This tool provides a set of default global estimates on contraceptive effectiveness based on the most recent research conducted by experts in the field of reproductive health and endorsed by the World

Health Organization.[1] However, we encourage you to use country-specific effectiveness measures where high quality estimates are available given that the effectiveness (a function of biological and social factors) can vary from population to population.

5. Procedures

5.1. Bongaarts variant

Bongaarts (1978, 1982) and Bongaarts, Frank, and Lesthaeghe (1984) describe variations in fertility as a function of the levels of a series of proximate, or intermediate, determinants (Davis and Blake 1956). In Bongaarts' view, the most important of these are (1) proportion married, (2) proportion of married women using contraception, (3) postpartum insusceptibility, and (4) induced abortion. Bongaarts, Frank, and Lesthaeghe argue that pathological sterility may be an important fifth proximate determinant in some populations. In Bongaarts' 1982 article, in Bongaarts and Potter (1983), and in Bongaarts, Frank, and Lesthaeghe (1984), the calculation of TFR as a function of the proximate determinants and the calculation of a series of indices are laid out. In Bongaarts' formulation:

$$TFR = C_m * C_c * C_a * C_i * C_p * TF$$

where:

  TFR is total fertility rate
  C_m is an index of marriage (proportion of women ages 15-49 in union)
  C_c is the index of contraception
  C_a is the index of abortion
  C_i is the index of postpartum insusceptibility
  C_p is an index of infecundity or pathological sterility
  TF is total fecundity (not a proximate determinant)

and

$$C_m = \frac{TFR}{TM} = \frac{\sum f(a)}{\sum f(a)/m(a)}$$

where:

  TM is total marital fertility rate, or the number of births a woman would have over her
    reproductive lifetime if age-specific marital fertility rates were to remain constant and if
    she were to remain married during the entire reproductive period
  m(a) is the proportion currently married or in a stable union among females, by age
  f(a) is a schedule of age-specific fertility rates

C_m may also be written as the sum of age-specific proportions married, *m(a)* weighted by age-specific
  marital fertility rates, *g(a)*, divided by the sum of age-specific marital fertility rates:

$$C_m = \frac{\sum m(a) * g(a)}{\sum g(a)}$$

$$C_c = 1 - 1.08 * u * e$$

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[1] A listing of sources for the default estimates of contraception method effectiveness is located in the "HELP" sheet of the Proximate Determinants of Fertility tool.

where:

> u is proportion of married women currently using contraception
> e is average contraceptive effectiveness (average of use-effectiveness levels by age and method)
> 1.08 is a sterility correction factor

$$C_i = 20/(18.5 + i)$$

where:

> 20 is the estimated typical average birth interval, in months, without lactation
> 18.5 is the average total duration, in months, of the postpartum infecundable period
> i is average duration (in months) of postpartum insusceptibility, the combined effect of both postpartum abstinence and lactational amenorrhea

$$C_a = TFR/(TFR + A)$$

where:

> A is the average number of births averted per woman by the end of the reproductive years due to induced abortion, or
>
> $$A = 0.4 * (1 + u) * TA$$
>
> where:
>
>> u is proportion of married women using contraception
>> TA is the total abortion rate, the average number of induced abortions per woman at the end of the reproductive period if induced abortion rates remain at prevailing levels over the reproductive period (excluding induced abortions to women who are not married (Bongaarts 1978:114)

$$C_p = \frac{7.63 - 0.11 * s}{7.3}$$

where:

> 7.63, 0.11, and 7.3 are constants based on the results of a regression on the proportion of women childless versus the total fertility rate for populations in Sub Saharan Africa (Frank, 1983).
> s is the proportion of women aged 45-49 who have had no live births.

TF is the total fecundity rate, equal to the total natural marital fertility rate in the absence of lactation (Bongaarts 1978:116). Bongaarts (1982:180) indicates that TF falls within the range 13 to 17 for most populations, with a mean of about 15.3.

5.2.   Stover variant

In 1998, John Stover published a modification of the proximate determinants model taking into account additional empirical data accumulated since the initial formulation by Bongaarts.

In Stover's revision:

$$TFR = C_x * C_u * C_i * C_a * C_f * PF$$

where:

       TFR is total fertility rate
       C_x is an index of sexual activity
       C_u is the index of contraception
       C_i is the index of postpartum insusceptibility
       C_a is the index of abortion
       C_f is an index of infecundity
       PF is potential fertility

and

C_x is the proportion sexually active women in the last month plus women who are not now sexually active but who are currently pregnant or abstaining postpartum. (Stover 1998:256)

C_u is a weighted average of contraceptive use, with use-effectiveness used as weights, but calculated for sexually active women rather than for married women. The change in reference population accounts for the change in notation, from C_c to C_u.

C_i is the average duration of postpartum insusceptibility, as defined previously.

C_a is the index of abortion as defined previously, but now calculated with use-effectiveness:

$$C_a = \frac{TFR}{TFR * 0.4 * (1 + u * e) * TAR}$$

where *TAR* is the total abortion rate (Bongaarts' TA term) (Stover 1998:258)

C_f is the sum of proportions of women who are menopausal and women who report themselves to be infecund for some other reason.

$$C_f = 1 - f$$

where f is the proportion of sexually active women who are infecund (Stover 1998:258-259)

PF is potential fertility, defined as the total fertility rate for a population of women who are sexually active and fecund for the entire period from age 15 to 49 and who do not practice breastfeeding, experience postpartum abstinence, or practice contraception. This definition of total fecundity implies a default value of about 21 with a range of 18 to 24. (Stover 1998:262)

5.3.   The relative versions of the proximate determinants model

The proximate determinants model was developed as a tool for quantifying the influence of the four or five intermediate variables most responsible for variation in fertility from one population to the next. However, because fecundity, or potential fertility, varies across populations, it may be useful to estimate TFR from a survey using an estimate from a separate source. The relative version of the model can also be used to assess consistency between two survey-based TFR estimates. The relative version of the Bongaarts model may be written as:

$$rTFR_{2,1} = TFR_1 * \frac{\left(C_m * C_c * C_a * C_i * C_p * TF\right)_2}{\left(C_m * C_c * C_a * C_i * C_p * TF\right)_1}$$

where the subscripts 1 and 2 denote an initial—or first survey—estimate, and a second survey-based estimate, respectively

The Stover variant is:

$$rTFR_{2,1} = TFR_1 * \frac{(C_x * C_u * C_a * C_i * C_f * PF)_2}{(C_x * C_u * C_a * C_i * C_f * PF)_1}$$

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